

## **Developing a Systematic Patent Search Training Program**

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**Abstract**

This study aims to develop a systematic patent training program using patent analysis and citation analysis techniques applied to patents held by the University of Saskatchewan.

The results indicate that the target audience will be researchers in life sciences, and aggregated patent database searching and advanced search techniques should be included.

**Introduction**

Traditional scholarly publications such as journal articles, books, and conference proceedings have been the major information sources for academic researchers. With the fast development of technology and innovation, patent documents are becoming an increasingly important primary scholarly information source. Patents are government grants that give inventors the exclusive right to make, use, or sell an invention. In exchange, inventors must fully describe the invention so that others can benefit from this advance. Because of the unique characteristics of patent documents, they provide certain advantages over other kinds of information sources. First, about 600,000 patents were granted worldwide each year recently, covering almost every field of technology. However, two-thirds of the technical information disclosed in patent documents is never published elsewhere<sup>1</sup>. Second, patents usually disclose the newest technology or process, therefore, it is useful for researchers to keep abreast with the development in a field and get ideas for further innovation. Third, patent documents often have a standardized format. In addition to bibliographic information and abstract sections, patent documents must describe the technology in full detail, and, in most cases, provide drawings illustrating how the invention is achieved. These unique features make possible for others

to find explicit and ready solutions to technical problems. In addition, data from patents are important indications to evaluate an institute's research and development output.

However, despite the advantages of patent documents as an information source, they are still an underutilized information source for research and development, particularly in non-industry settings <sup>2</sup>. For example, Church and Carpenter found that biologists did not generally consult information in patents although patent activity has been proliferating in biological sciences <sup>3</sup>. Several reasons might have impeded scientific researchers to access patent information. First, there is very limited promotion of the awareness and the usefulness of patent literature within universities and other academic settings <sup>4</sup>. Second, patents are often written in "patent jargon", making them significantly differ from other types of scholarly publications <sup>5</sup>. Although special instructions are usually needed to read and understand the structure and contents of patents, when compared to other kinds of information literacy programs, education on patents as an information source is not widely available in university settings <sup>6</sup>.

Since early 1990s, universities have become more and more entrepreneurial and have expanded substantially their R&D mission to include commercializing of intellectual property, namely patents <sup>7</sup>. This trend was first a result of resource contraction and increased competition for funding among universities. [Figure 1](#) shows the number of the US university-owned utility patents granted by the United States Patent and Trademark Office (USPTO) from 1992 -2005. It can be seen that, as a reflection of R&D expansion, patenting in universities has been growing significantly from 1992 <sup>8</sup>. Technology transfer

has generated significant revenue to support the academic enterprise, outpacing the increase in any other source of academic R&D funding. For example, while the US federal R&D funding for universities increased 51% from 1991 to 1999, the revenues from technology transfers increased 340% during the same period <sup>9</sup>. Moreover, universities have also been recognized as a resource and engines of economic innovations during this entrepreneurial development <sup>10</sup>. Academic libraries, as one of the key supporters of R&D activities on campus, need to respond to these changes and provide better information support to the proliferation of patenting activities. However, in most academic library, this type of support is usually provided only by a small body of librarians specializing in patents, and many other librarians are not familiar or comfortable with patent information source. Therefore, it is essential for more librarians to have an understanding of patents and their utility for R&D.

As discussed above, incorporating patent information in research activities will help researchers in many ways. The University of Saskatchewan (UofS) Library is committed to contribute to the success of researchers and scholars in the university community. The Library has been receiving requests for patent information from library users, and responded by offering patent search workshops including both group and one-on-one instruction upon request. The main components of these workshops include basic patent knowledge, interpretation of patent documents, and searching the USPTO database. Although the feedback was generally positive, these sessions were reactive, lacking a systematic and proactive approach to the patent search training program. Therefore, it is

important to develop a systematic patent search training program and include it as an integral part of the information literacy programs.

A range of research methods have been used to design information literacy programs by academic librarians. These include questionnaires, pre-tests and post-tests, focus groups, and interviews <sup>11</sup>. As well, citation analysis, a branch of bibliometrics, is another research method that has been widely used in collection management and research work evaluation, although few studies have used this technique to develop information literacy programs by analyzing students' assignments. For example, Yu and colleagues analyzed the bibliographies of design project reports from engineering students, and concluded that the emphasis of information skills programs needs to shift from merely finding information to include interpreting and citing it accurately <sup>12</sup>. This study also suggested that different research topics may have different citation patterns. Kraus used citation analysis to identify the information sources used in biology students assignments <sup>13</sup>.

Patent analysis is another branch of bibliometrics. It has been mainly used from a business perspective to identify core technologies, measure research outputs, and predict industrial trends, thus providing evidence for technological policy decision making. For example, Chen and colleagues conducted a patents analysis, utilizing the USPTO classification system, to identify core technologies and key industries in Taiwan <sup>14</sup>. However, there is little research discussing the use of patent analysis in library fields, except one study by Gupta suggesting that information found through patent analysis could be used to improve information support <sup>15</sup>. This study explores using both patent

analysis and citation analysis techniques to develop a systematic patent search training program.

### **Objective**

The main objective of this study is to develop a systematic patent search training program by utilizing evidence found in patents owned by the University of Saskatchewan.

Specifically, the study will examine the following questions:

- A. Is there an increasing need for patent information?
- B. What are the key research fields of the University?
- C. What is the citation pattern (i.e., types of information sources used) in these patents?
- D. Which countries granted the patents cited by inventor(s)?

The answer to Question B will help determine the target audience for the training program. The answers to Question C and D will provide evidence for designing the contents of this program.

### **Methods:**

Delphion Intellectual Property Network database was searched to identify patents owned by the University of Saskatchewan in August 2007. Collections searched included US patents (granted, from 1971), German patents (granted, from 1968), European patents (granted, from 1980 ), World Intellectual Property Organization (WIPO) Patent Cooperation Treaty (PCT) Publications (from 1978 ). The term “University of Saskatchewan” was searched in the Patent Assignee field. The results were exported to

Reference Manager for analysis. Patent duplicates and patent applications were then purged. For this study, a patent duplicate is defined as the same invention patented in different countries. The full-texts of these patent documents were obtained.

Each patent document was screened manually. The application date and issuing date of each patent were recorded. The references used by inventors were categorized into: patents, journal articles, books, conference proceedings, thesis and dissertations, standards, websites, and other types. The patents cited were further categorized by granting country: US, Europe, Canada, WIPO, Japan, and other countries. In USPTO patent documents, there is a separate section listing references provided by patent examiners. Because the purpose of this study is to identify citation patterns of inventors/researchers, the references provided by examiners were not included.

In order to identify the key research fields of the University, a modified research field classification system was developed. In the Delphion database, each patent was assigned at least one International Patent Classification (IPC) code based on the different areas of technology to which a patent pertains<sup>16</sup>. However, some of the classification sections of IPC were not applicable to the University of Saskatchewan. For example, Section D “Textiles; Paper” of IPC is apparently not a research field of the University. Because this study is related to the research fields of the University, it is necessary to take into account of the academic programs offered at the University. Therefore, a modified research field classification was developed based on both IPC and the programs offered at the University. A calibration exercise proceeded before finalizing the classification system,

which includes the following research fields: Agriculture, Biochemistry (including microbiology and genetics), Chemistry, Electricity, Medical Sciences, Physics, and Veterinary Sciences. Each patent was assigned a research field.

## **Results:**

By searching the Delphion database, 352 patents were retrieved, of which 186 were duplicates. 50 patent applications were also excluded, thus 116 patents were included for this study.

### **Patents owned by the University of Saskatchewan by year**

The first UofS held patent was granted in 1981. From 1981 – 1992, the number of patents owned by UofS was sparse, with one or two in each three-year period (See [Figure 2](#)). As the university's research and development capability had grown along the way, the number of patents increased to 10 during the period of 1993-1995. 1999-2001 saw a big jump in the number of patents to 26. After that, the number of patents has maintained a level of about 25 each period. [Figure 1](#) and [Figure 2](#) show a similar trend of patenting activities, suggesting that universities in the United States and Canada may have been experiencing similar entrepreneurial development. [Figure 2](#) also shows that the number of patents granted during the period of 2006-2007 was only 13, but it should be noted that this is a two-year period. The average time between patent application and patent granted was 3.74 years (SD 1.94). During the nine years from 1999-2007, the total number of patents reached 89, an increase of 230% compared to the total number of patents during previous eighteen years from 1981-1998. These results indicate that research outputs have been increasing significantly in the last 10 years at UofS. As the research and



development activities at UofS intensify, researchers and scholars will likely require more and different information support. Thus, providing patent information support to the potential inventors is becoming an important component of the information literacy programs.

### **Types of references**

Of 116 patents held by the Uof S and examined in this study, the inventors cited references to patent literature in 102 (88%) patents, to journal articles in 108 (93%) patents, to books in 89 (76%), to conference proceedings in 24 (21%). Other reference types cited included manuals, software, websites and standards. In total, 6919 references were cited in the 116 patents. The average of total references cited per patent is 59.6. The details of the references cited are listed in [Table 1](#). Journal articles were cited most frequently, consisting of 58.1% of the total reference types cited. Patents ranked second with 27.8%; books were also used commonly by inventors with a percentage of 11.5%; and conference proceedings appearance rate was 0.5%. All the other types of references including standards, websites, thesis and dissertations, manuals, software, etc were used insignificantly across the 116 patents. When the reference types were classified as patents versus non-patents (which include journal articles, books, conference proceedings, etc.), the average of number of non-patent references is more than two and on-half time (260%) of that of patent references. The results indicate that journal articles, patents, and books are the major types of references used by inventors and researchers at the UofS, and non-patent references are used more often than patent references.

### **Country-wise references to patent literature**

The patent references used by inventors were granted by different countries ([Figure 3](#)). Of the total 1920 patents cited by inventors, 1421 (74%) were granted by US, 289 (15%) were granted in Europe, 180 (9%) were granted by WIPO, 15 (1%) were granted by Japan. The rest of 15 (1%) were granted by other countries including Canada, Australia and China. The results indicated that the majority of patents cited by UofS inventors were those granted by the US. This is not surprising because the United States is generally recognized as the largest technology market, however, patent information from other countries also contributed significantly to the research activities.

### **Key research fields**

Based on the highest number of patents, the most important research fields at the UofS during the period from 1981 – 2007 were Medical Sciences, Biochemistry, Veterinary Sciences, Agriculture, Chemistry, Physics, and Electricity. [Figure 4](#) illustrates the number of patents in each field. The results indicate that the University's key research fields include life sciences (i.e., Biochemistry, Medical Sciences, and Veterinary Sciences), agriculture and chemistry in terms of research output, and the output from engineering discipline (i.e., Physics and Electricity) is somewhat slight.

In order to find if there are different citation patterns across disciplines, the citation patterns in the engineering discipline were compared with the life sciences discipline. The average number of references used in engineering is 9.6 per patent, significantly less than that in life sciences (72.6 per patent,  $p < 0.01$ ). It was noted that, across the 116

patents, no references were used in 4 patents -- 2 in the field of Physics, 1 in Electricity, and 1 in Agriculture. A closer look of the patent in Agriculture found that it can also be categorized as engineering. These findings suggest that the patents in engineering discipline have a different citation pattern from those in life sciences discipline, implying that researchers in the two disciplines may have different information behaviors.

## **Discussion**

During the last decade, commercialization of research and scholarly work in the sciences has been increasing significantly at the UofS, as evidenced by the fact that the number of patents held by the institution has tripled in the last decade compared to the previous 18 years. As inventive activities intensify, there will be increased demands for patent information from the researchers at UofS. This is also confirmed by the author's observation that more patent-related information requests have been received during the last few years. Therefore, the library needs to adapt and provide a more systematic approach to patent information support to the users.

This study found that, the average number of non-patent references used by inventors and researchers at the UofS is 260% of that of patent references, indicating that they have demonstrated better capabilities in searching for prior art in non-patent information sources than in patent information sources. Prior art refers to "all information that has been disclosed to the public in any form about an invention before a given date"<sup>17</sup>. The University of Saskatchewan Library provides an intensive information literacy program for its user community, including students, faculty, researchers and practitioners,

particularly in the life sciences discipline. The fundamental content of these programs includes instruction in scientific database searching for journal articles, and catalogue searching for books. One finding from this study indicates the information literacy program as provided is successful.

On the other hand, this study shows that researchers at UofS are using significantly less patent literature, despite the advantages of patents as an information source. Patents as an information source are still relatively new to many academic researchers, and not many of them are aware of the wealth of technical information that patents can provide.

Further, there is a difference in terms of complexity and scope between patent database searches and scientific database searches. Even when researchers do use patent information sources, they may lack technical skills to make a comprehensive search of relevant patent references in the prior art <sup>18</sup>. Many government agencies including USPTO, EPO, WIPO, etc. have made their patent documents free online since last few years. More recently, several worldwide open access free patent information resources such as Google Patents, Patent Lens and Free Patents Online have been established. All these efforts have made patent documents more accessible and easier to search.

Moreover, when compared with many scientific databases, a unique feature of these patent resources is that they all provide full-text documents free, which substantially increases the amount of technical information available without additional financial burdens to users or libraries. Academic libraries need to promote patent information resources, and encourage library users to take full advantages of them. When planning the patent search training program, advanced search skills should be covered in addition

to basic patent knowledge and basic patent search techniques in order to help researchers conduct a more comprehensive search of prior art. Some of the advanced skills may include identifying and searching by patent classification systems such as IPC and USPTO Classification. Patent citation searching can also be introduced in this program to increase the comprehensiveness of prior art search.

In this study, the patents cited by the UofS inventors were mainly granted by USPTO, EPO, WIPO, and Japan, indicating that the inventive activities at UofS have been largely building on the technical information from those countries/organization. Therefore, the patent search training program should provide information on searching for patents in those countries. The literature on patent search training is slight, focusing on searching individual government patent databases, particularly the USPTO patent database <sup>19</sup>. Though the United States is generally recognized as the largest technology market, technology from other countries is also important. Therefore, the USPTO database may not be the only choice for patent searchers. Several free online patent databases such as esp@cenet, Patent Lens and Google Patents provide aggregated access to patents granted by different countries, whereas the USPTO provides US patents only. In addition, the USPTO requires installing a special TIFF software to view patent images, which may impede some users' accessibility. On the other hand, esp@cenet, Patent Lens and Google Patents display the images in PDF format, which is more user-friendly. Therefore, when designing the patent search program, aggregated patent databases should be given precedence over individual government patent databases.

This research also identifies some challenges to the patent search. Although the patents from Latin-based language countries are of most importance, the patents from non-Latin-based languages such as Japan, China and Korea cannot be ignored as these countries are becoming more and more competitive in technology innovation. This information and the knowledge to overcome language barriers need to be conveyed to the audience, requiring librarians keep abreast of the development in patent information. For example, Thompson Innovation has recently included English translations of full-text Japanese patents.

When comparing inventive activity at the UofS in the life sciences and engineering disciplines, the key research fields include medical sciences, biochemistry, veterinary sciences, agriculture, and chemistry. The UofS is in a strong position in life sciences, agriculture and chemistry in terms of research output, therefore, a patent search training program should target to the researchers and scholars in those key research fields.

The average number of references used in the engineering discipline is significantly less than that in life sciences. Three engineering patents did not use any references at all. Several studies investigating engineers' information seeking behaviors found repeatedly that personal communication was the main information source used by engineers and scientific literature was least used. This study confirmed their findings in a quantitative way. Fidel and Green identified that accessibility was the most important factor that influenced engineers' selection of information sources<sup>20</sup>, implying that patents, as a freely accessible full-text information source, could become a valuable information source to engineers if a wide range of promotion is launched. Patent documents include

full descriptions and drawings illustrating how a product or a process is achieved, thus providing unique technical information to engineering projects, though not necessarily new inventions. A patent search training program should include promotion to key groups such as engineers.

## **Conclusion**

This study used patent analysis and citation analysis techniques to develop a systematic patent search training program for the researchers at the University of Saskatchewan that can be applied in other academic institutions.

In developing a systematic patent search training program, the following several elements need to be considered. First, it is essential that patent information searching be integrated into library instructions. For example, this training need to be offered to the upper year science students involved in research courses/projects, engineering students involved in design projects, and upper year business students. Second, when delivering this patent training program to researchers, identifying target audience is important because users learn better when they have a real need. This can be completed by analyzing key research fields based on the IPC and the academic programs offered at your institution. This patent search training will include basic patent knowledge, basic patent search techniques, as well as advanced search techniques such as use of the patent classification system and introduction to patent citation searching. Third, librarians need to promote the value of patent information sources to prospective users stressing the content and accessibility. The promotion will focus on the wealth of technical information in patents, the

availability of online patent resources, the value of aggregated patent databases, and the knowledge to overcome barriers of non-Latin-based language patents. Fourth, librarians themselves need to expand their knowledge about patents. In institutions where there are librarians specializing in patent information, they should take a lead role in this campaign and train other librarians to be familiar with patent information.

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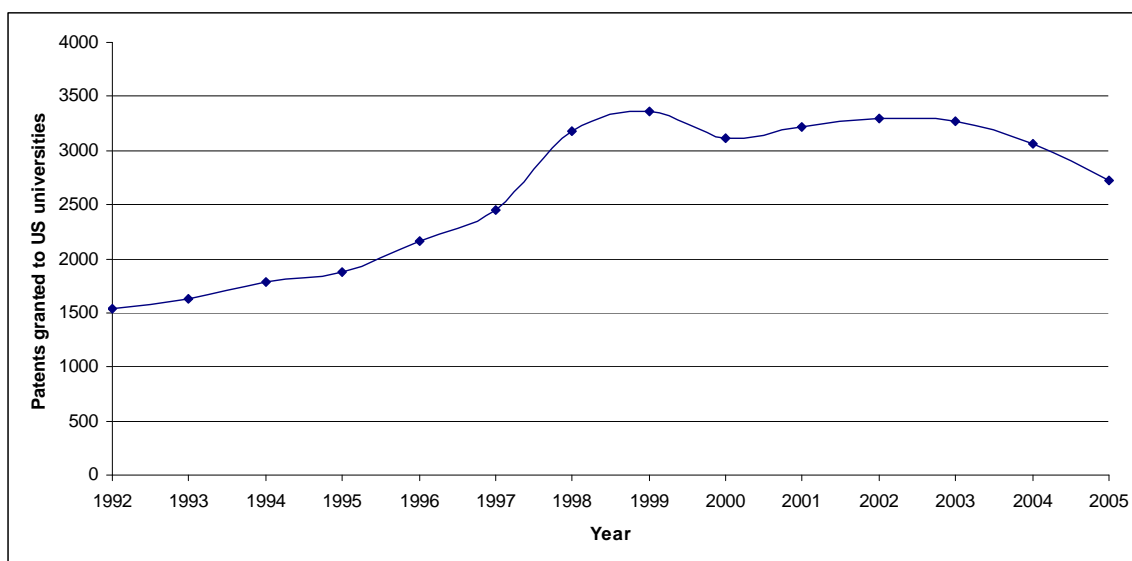
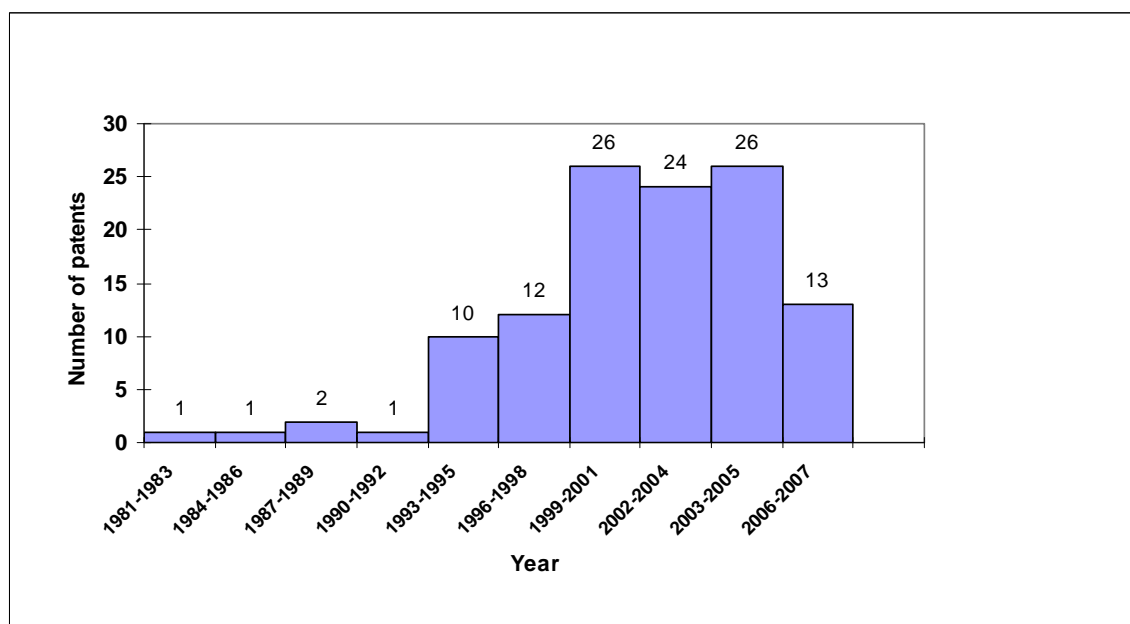


Figure 1. Patenting activity of the US universities, granted by USPTO  
Source: United States Patent and Trademark Office, 2007



[Figure 2](#). Number of patents owned by the UofS by year

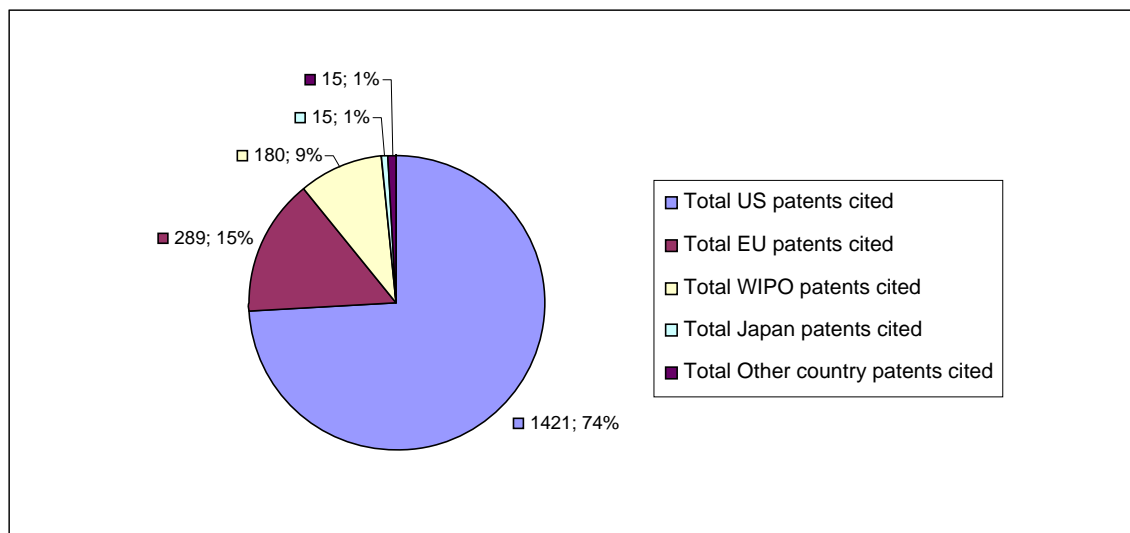


Figure 3. Patents cited by granting country (number; percentage)

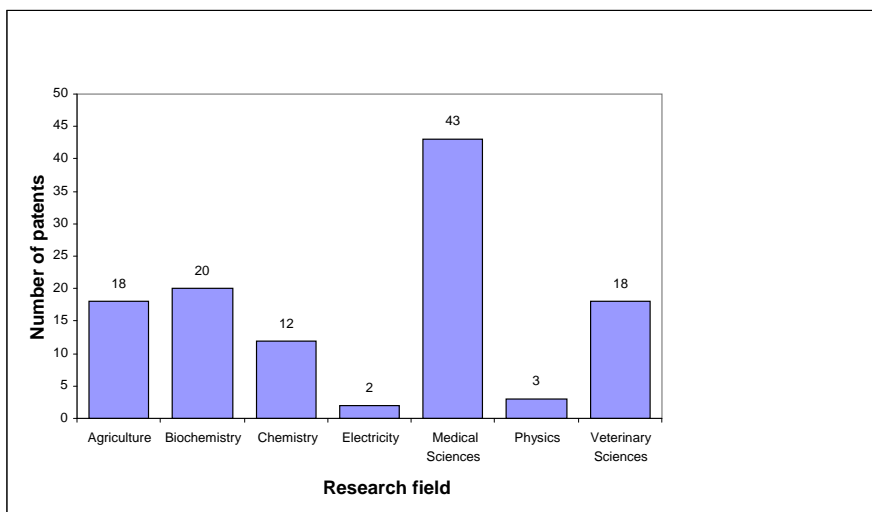


Figure 4. Number of patents by research field

Reference type	No. of references	Average/patent	Percentage
journal articles	4023	34.7	58.10%
patents	1920	16.6	27.80%
books	794	6.9	11.50%
Conference proceedings	36	0.3	0.50%
standards	1	n/s	n/s
websites	3	n/s	n/s
Theses and Dissertations	7	n/s	n/s
other reference types	135	n/s	1.90%
total references	6919	59.6	100%

Table 1. Analysis of reference types cited by inventors in UofS-owned patents.  
n/s – not significant